2012

Soil and Plant Fertility Management for Soybeans

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Abstract
Producers utilizing a two year rotation of corn and soybean often apply fertilizer on a biannual basis, spreading recommended amounts of phosphorus and potassium for both crops prior to corn establishment. This approach minimizes application costs and is in accordance with university fertility recommendations that have found a low probability of fertilizer yield response when soils tested at the medium/optimum level or above. However, the field trials on which these state recommendations were developed are often several decades old. Increases in average corn and soybean yields and associated increases in crop nutrient removal rates have called into question the validity of these recommendations for current production environments. This study investigated the response of soil test levels and grain yield to annual and biannual fertilizer applications made at 1x and 2x rates of current university fertilizer recommendations.

Keywords
RFR A11106, Agronomy

Disciplines
Agriculture | Agronomy and Crop Sciences

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RFR-A11106

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Introduction

Producers utilizing a two year rotation of corn and soybean often apply fertilizer on a bi-annual basis, spreading recommended amounts of phosphorus and potassium for both crops prior to corn establishment. This approach minimizes application costs and is in accordance with university fertility recommendations that have found a low probability of fertilizer yield response when soils tested at the medium/optimum level or above. However, the field trials on which these state recommendations were developed are often several decades old. Increases in average corn and soybean yields and associated increases in crop nutrient removal rates have called into question the validity of these recommendations for current production environments. This study investigated the response of soil test levels and grain yield to annual and biannual fertilizer applications made at 1x and 2x rates of current university fertilizer recommendations.

Materials and Methods

Research trials were established at three sites across Iowa. The sites were located at the ISU Bruner Farm, Ames, the ISU Armstrong Research Farm, Lewis, and the ISU Northwest Research Farm, Sutherland. Corn was planted in the first year and followed by soybeans in the second in accordance with local management practices. Corn-soybean rotations were initiated in 2009 and 2010. Fertilizer application rates were determined by local state fertility recommendations from soil samples collected prior to planting in 2009. In cases where soil test values called for no additional fertilizer, crop removal rates were applied.

Fertility treatments consisted of a bi-annual application prior to corn in year one at recommended rates for both corn and soybean or an annual application before corn in year one and soybeans in year two at recommended rates for each crop. These timings were applied at 1x and 2x rates for a total of four treatments and compared with an unfertilized control treatment. Phosphorus was applied as monoammonium phosphate and potassium as potash. Treatments were replicated four times in a randomized complete block design.

Seed moisture and yield was recorded and yield was adjusted to 13.0 g kg^{-1} moisture. Data were analyzed with SAS statistical software (SAS Institute, Cary, NC). Analysis of variance was performed using PROC MIXED. Treatment effects were considered significant at the α=0.10 level.

Results and Discussion

Across all sites, no soybean grain yield response was observed from fertility treatments (Table 2). At Ames in 2010, significant treatment effects were seen (Table 2). At Ames in 2010, all fertility treatments increased yield compared with the untreated control (Table 2). Ames tested low for both P and K (Table1). No yield response was observed to fertility treatments in 2011 at Ames. No treatment differences were observed at other sites testing below optimum for P or K (Table 2).

Further analysis of corn grain response to fertilizer applications and temporal changes to soil test P and K is ongoing for inclusion in a final manuscript. This report consists of excerpts from the 2011 six state United Soybean Board preliminary soybean study report.

Table 1. Initial soil test P and K levels as ppm.

Site	Soil test P[†]		Soil test K	
Lewis	9	Low	160	High
Sutherland	20	Opt	198	V High
Ames	11	Low	82	Low

[†]Soil test P as determined by Bray-1.

Table 2. Iowa soybean grain yield response to fertilizer P and K application.[a]

	Lewis	Sutherland	Ames
2010		---------- bu/ac ----------	
Control	64.9	74.2	57.8 b
1x Annual	66.7	73.3	63.8 ab
2x Annual	64.3	74.3	64.3 a
1x Biannual	68.0	76.8	64.1 ab
2x Biannual	66.6	73.8	60.6 ab
P>F	0.4448	0.5216	0.0131
2011			
Control	68.9	59.6	55.6
1x Annual	66.4	62.9	61.0
2x Annual	70.4	62.7	57.6
1x Biannual	71.2	64.5	59.4
2x Biannual	68.9	63.2	61.6
P>F	0.1193	0.1387	0.8484

[a]Means in the same column with different letters differ (P>0.02).